

インドネシア・バトゥールおよびブラタンカルデラの噴火史 Explosive eruptions associated with Batur and Bratan calderas, Bali, Indonesia

古川 竜太^{1*}, 高田 亮¹, 土志田 潔², Supriyati ANDREASTUTI³, Eka KADARSETIA³, Nugraha KARTADINATA³, Anjar HERIWASESO³, Oktory PRAMBADA³, Yudi WAHYUDI³, Nizar FIRMANSYAH³
FURUKAWA, Ryuta^{1*}, TAKADA, Akira¹, TOSHIDA, Kiyoshi², Supriyati ANDREASTUTI³, Eka KADARSETIA³, Nugraha KARTADINATA³, Anjar HERIWASESO³, Oktory PRAMBADA³, Yudi WAHYUDI³, Nizar FIRMANSYAH³

¹ 産業技術総合研究所地質調査総合センター, ² 電力中央研究所, ³ インドネシア火山地質災害減災センター

¹ Geological Survey of Japan, AIST, ² Civil Engineering Research Laboratory, Central Research Institute of Electric Power Industry, ³ Center for Volcanology and Geological Hazard Mitigation

In Sunda Arc, caldera forming eruption is frequent as occurring 3 times in recent 1000 years. The future caldera forming eruption in Bali should be evaluated from scientific procedure. Our geological study is a corporate work between Indonesia and Japan supported by Japan International Cooperation Agency (JICA) and Japan Science and Technology Agency (JST). We highlight long-term volcanic history of Bali Island, especially focusing on Batur and Bratan calderas including some peripheral volcanoes. We offer a significant contribution towards hazard mitigation at the forthcoming volcanic eruption. Bratan and Batur calderas are the most famous tourist places in Bali Island and are probable candidate of world geopark. The calderas have prominent depression of 12x8 km and 14x10 km respectively. The calderas are surrounded by flat plateau consist of major pyroclastic flow deposits with subordinating pyroclastic fall deposits and soils. Mt. Agung lying on east of Batur is a undissected stratovolcano with no caldera. As Bratan and Batur calderas are formed by multiple caldera forming eruptions, we need to evaluate long-term forecast of probable caldera-forming eruption. From 2009 to 2011, we have described more than 200 exposures and have made stratigraphic logs to correlated each deposit which allow us to reconstruct the eruptive history of Bali Island. We newly identified 7 extensive pyroclastic flow deposits which correspond to formation of Batur and Bratan calderas respectively. Radioactive carbon ages of carbonized wood and underlying soil ranges from ca. 29 to 6 ka. We also discovered more than 10 plinian pumice and/or scoria fall deposits extensively blanketing west of the Batur caldera. We identified scoria fall deposit from Agung volcano covering Batur area. It suggests sustaining concurrent activities of the Bali volcanoes. Oldest eruptive products we identified is 29 thousand years before made of plinian pumice fall and overlying pyroclastic flow deposit. Both deposits respectively thicken toward the present Batur caldera suggesting their source. Southern distribution of pyroclastic flow deposit is not sure, because this area is densely populated and lacks outcrops. But southern part of Bali supposed to be isolated island and connected by the sediment supply from the Northern volcanic regions to erupt. Caldera rim formed by this eruption is not confirmed. Carbonized wood root beneath this pyroclastic flow deposit has radioactive carbon date of 23760±70 years B.P. Next large eruption is 17 thousand year before consists of pumice fall to the southwest and overlying pyroclastic flow deposit. Outer caldera rim would be formed and proximal welded pyroclastic flow deposit filling inside of the caldera. At the lower non-welded pyroclastic flow deposit we found buried carbonized wood showing 14C age of 14370±70 years B.P. The next large eruption is 6ka also made of pumice fall deposit to the southwest and extensive pyroclastic flow deposit. The inner caldera rim must be formed. Sutawidjaja (2009) reported radiocarbon age for this pyroclastic flow deposit as 5500 years B.P. and we also obtained consistent age dating as 5550±50 years B.P. (calibrated to 6310 cal.y.BP). Youngest large eruption is four thousand years before. Pumice fall deposit blanketing west of Batur and relatively minor pyroclastic flow deposits intervened. Pyroclastic cone (Sayang) was also formed in southwest of caldera. We obtained the chronology and magnitude of large-scale explosive eruptions from Batur and surrounding volcanoes. Older volcanoes are basalt and andesite stratovolcanoes with no evidence of caldera formation. Age of them are shown by Toshida et al. (2010). For Batur and Bratan calderas, there are three caldera forming eruptions among last 30000 years (once in 10000years). We have less information from 4ka to present, and from 0.2 Ma to 30 ka.

Keywords: Bali, Batur caldera, Bratan caldera, explosive eruption, geology, eruptive history